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Federal Highway Administration

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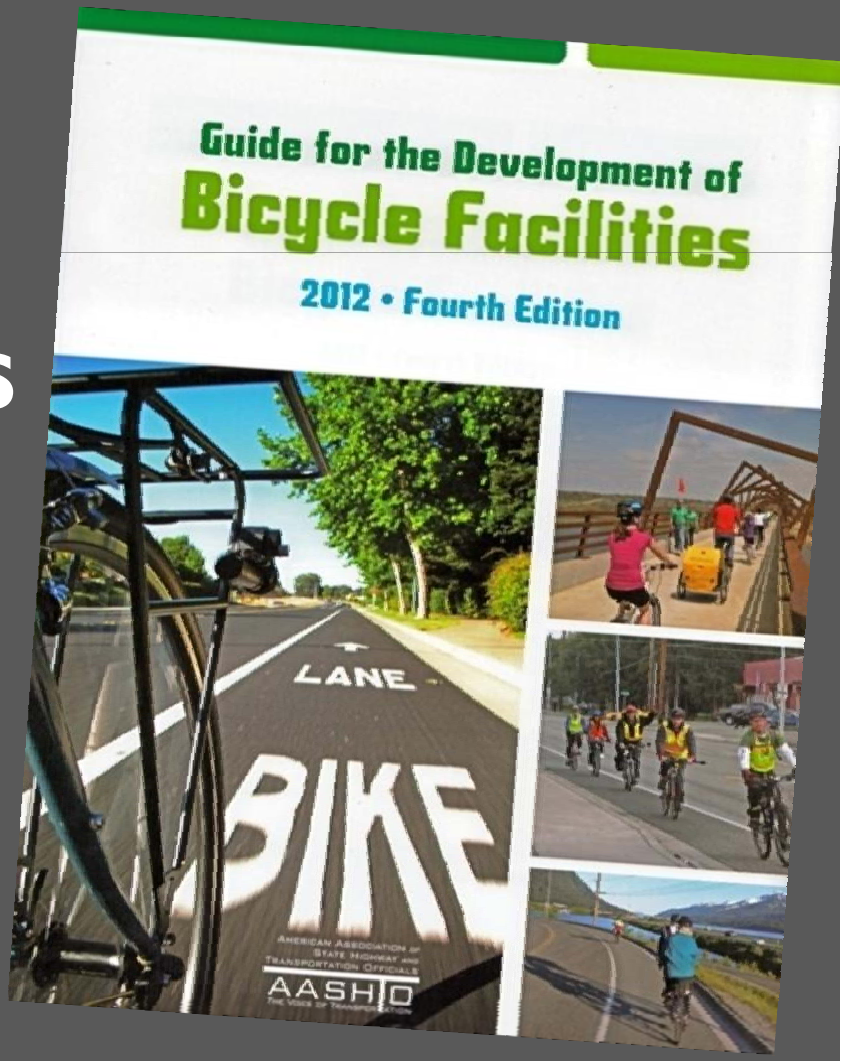
Pedestrian and Bicycle Information Center

On Road Bikeways Part 1: Bicycle Lane Design



Presentation by:
Nick Jackson
Bill Schultheiss, P.E.
September 04, 2012

Toole Design Group

FOLLOW THE CONVERSATION ON TWITTER

- Toole Design Group is live tweeting this webinar
  - @tooledesign
  - #AASHTO #BikeGuide

WEBINAR #3: ON ROAD FACILITIES PART 1: BIKE LANES AND INTERSECTIONS

Today's Webinar

- Significant Updates & New Content for bicycle lane design
  - Purpose & Benefits
  - Marking and Sign Basics
  - Intersections/Turns
  - Retrofitting

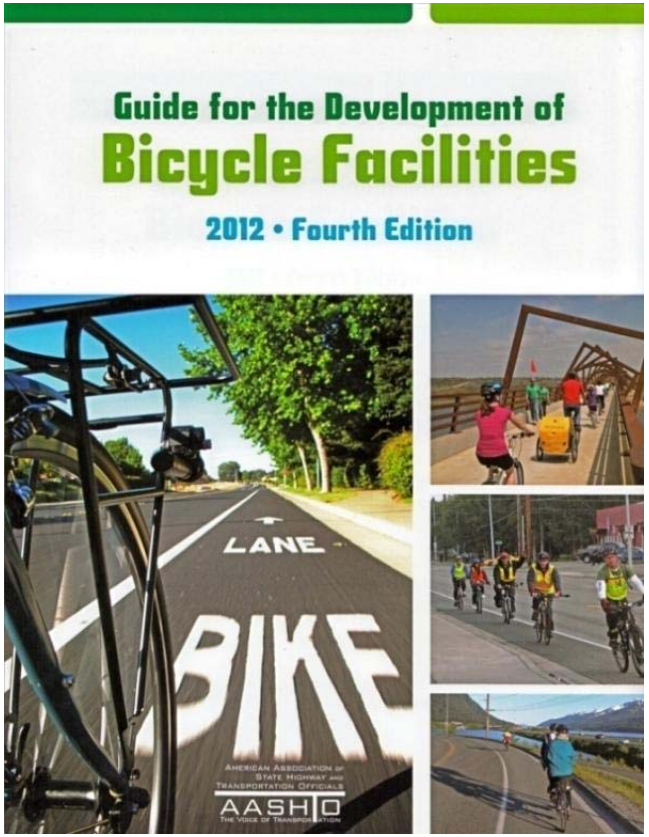
FUTURE WEBINARS

- August 10: Overview
- August 22: Planning Chapter
- **September 4: On-Road Bikeways Part I**
  - **Bike Lanes (including Intersections)**
- September 18: On-Road Bikeways Part II
  - Shared lanes
  - Bicycle boulevards & signing
  - Signals
- October 9: Shared Use Paths
  - General design principles
  - Pathway geometry
- October 23: Shared Use Paths
  - Intersection Design
  - Mid-block crossings
- November 6: Bikeway Maintenance and Operation

DISCOUNT FOR WEBINAR PARTICIPANTS

http://www.walkinginfo.org/training/pbic/AASHTO_Promo_Flyer.pdf

Link will be emailed to webinar attendees

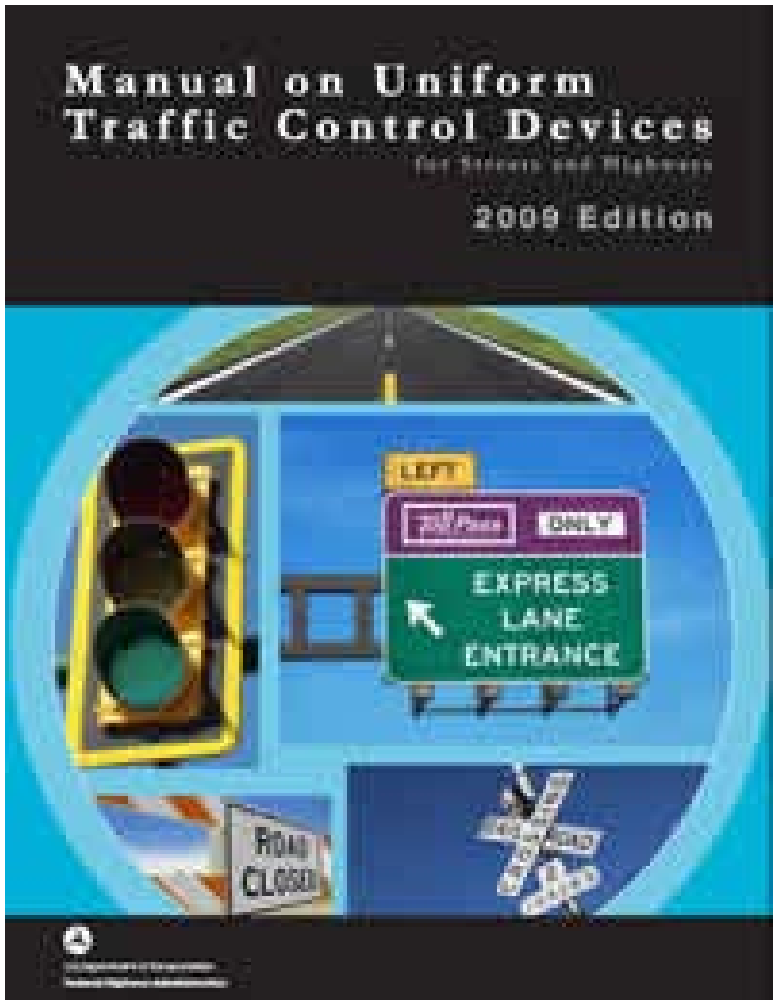


SOME BACKGROUND

- What is AASHTO?
  - Mission: "provides technical services to support states in their efforts to efficiently and safely move people and goods"
- Some history
  - Last Guide – 1999, largely written in 96-98
  - Survey to update Guide - 2004
- Standards vs. guidance (Shall vs. should or may)
- Relationship between AASHTO Guide and the MUTCD
- Innovation vs. accepted practice

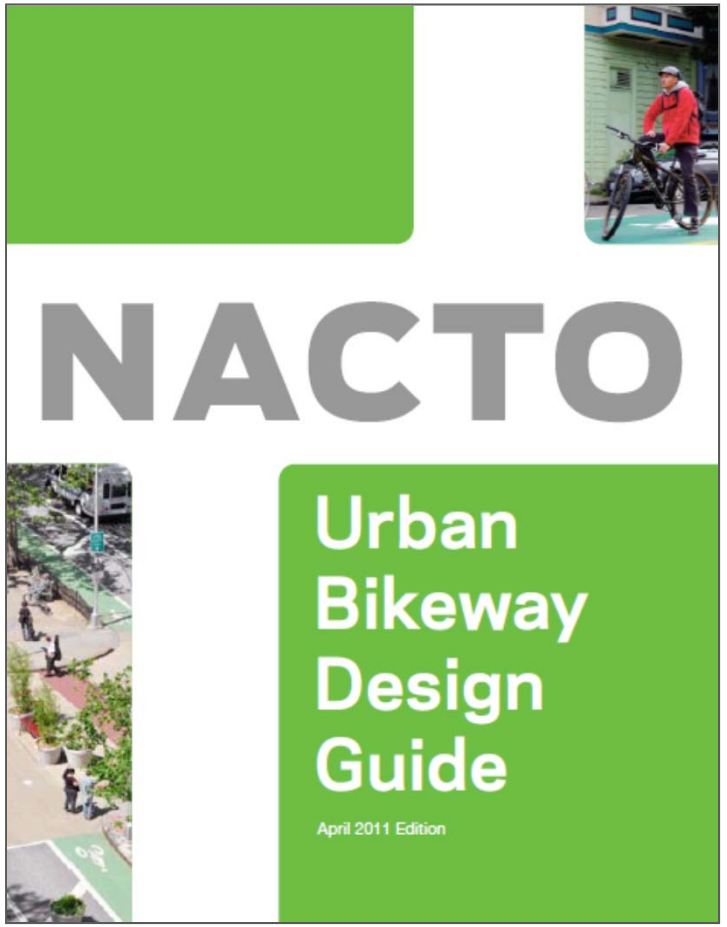
RELATIONSHIP TO OTHER MANUALS

- 2009 MUTCD – FHWA
- 2011 AASHTO Green Book
- Public Right-of-Way Accessibility Guidelines (PROWAG)
- 2010 Highway Capacity Manual



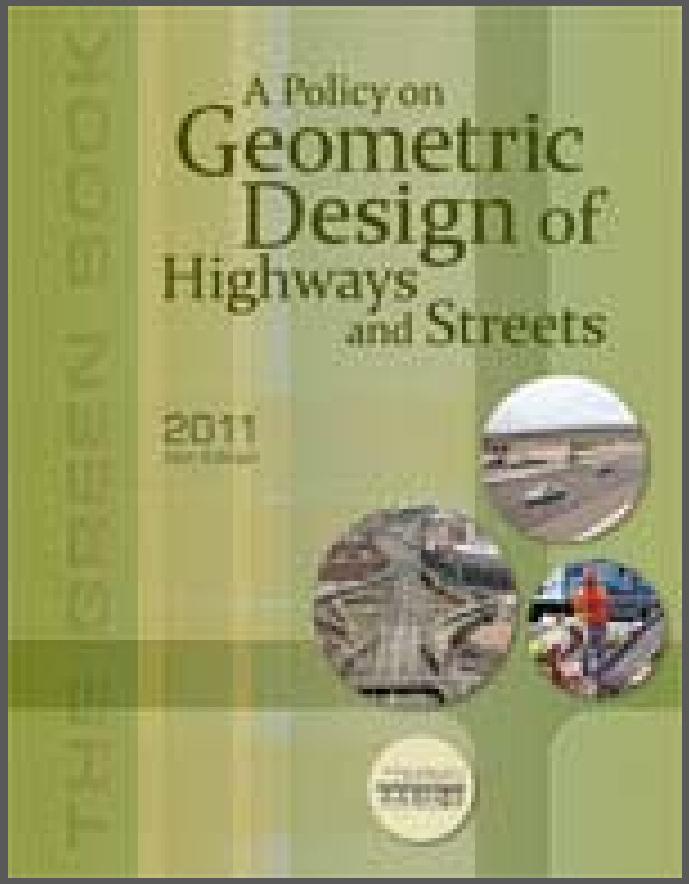
AASHTO VS. NACTO GUIDE: EITHER/OR?

- AASHTO covers paths + on-road bikeways
- AASHTO covers design comprehensively
- AASHTO covers many – but not all innovations
- NACTO is a source of information for solutions that are currently experimental



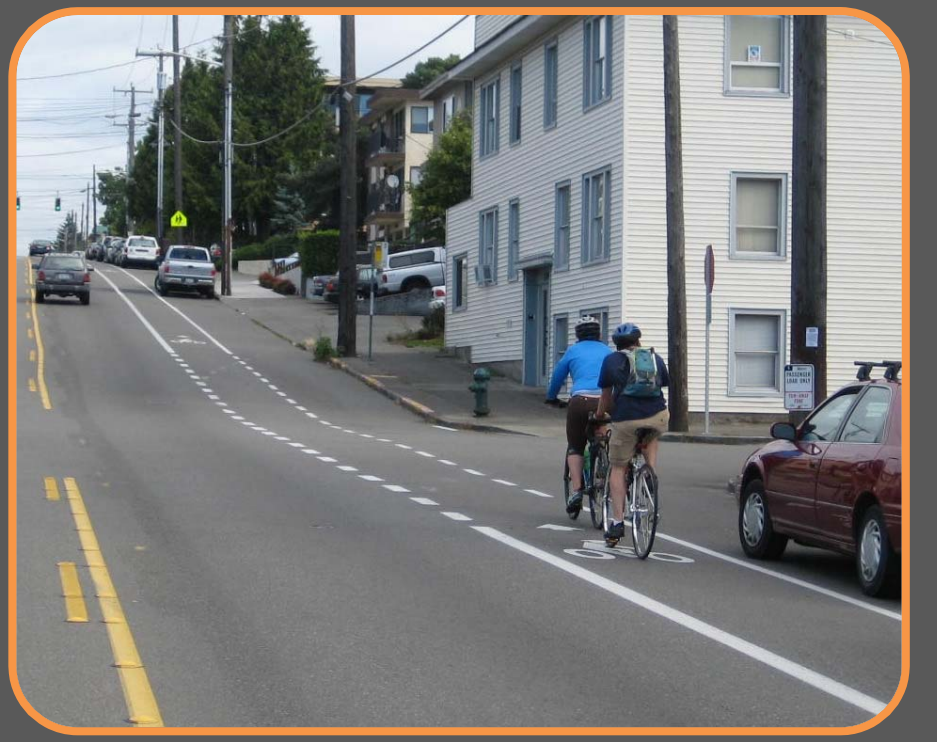
DESIGN GUIDANCE OF GREEN BOOK

- Streets designed to meet design principals of the "Green Book" will typically accommodate bikes by providing adequate:
  - sight distance
  - Vertical & horizontal curves
  - Cross slopes



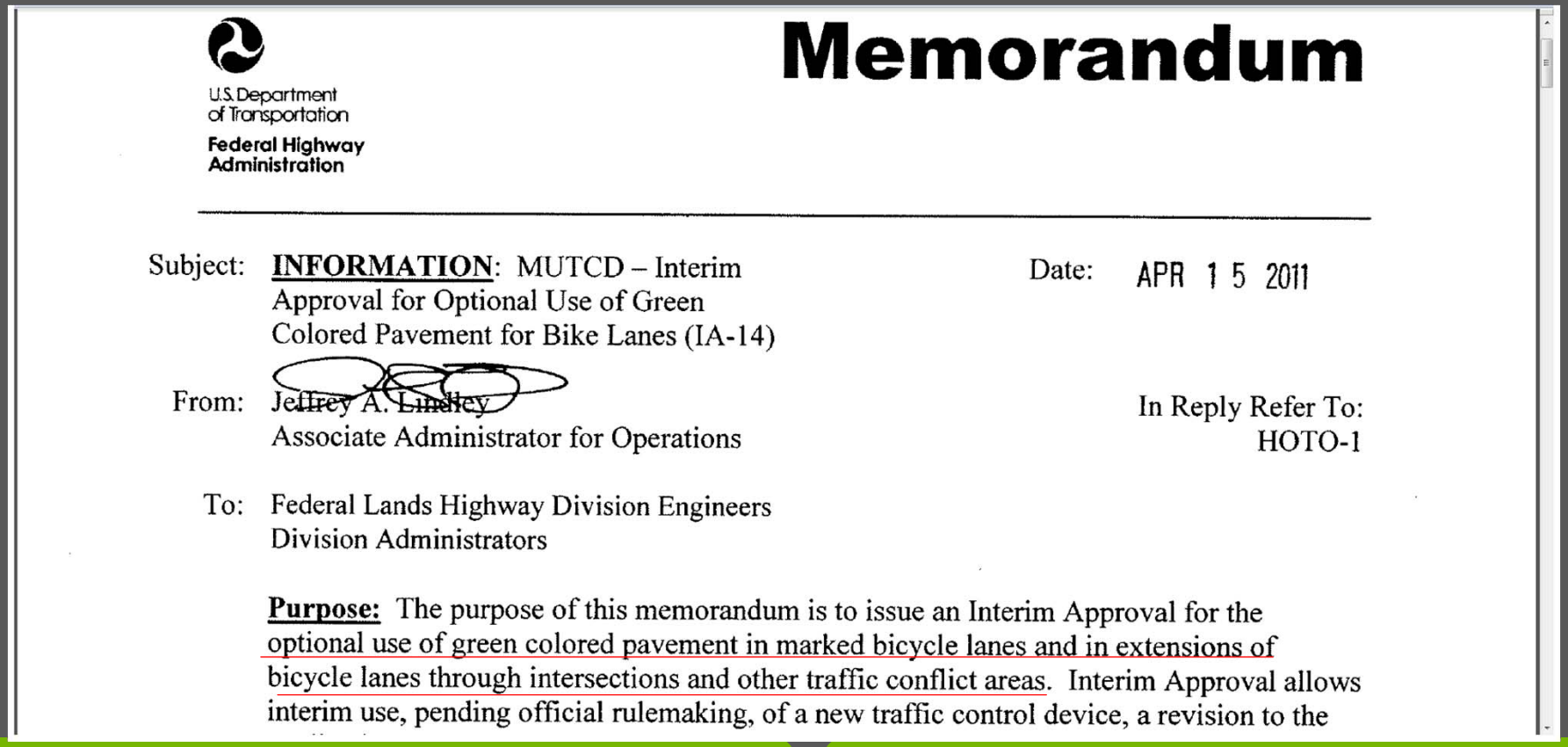
DESIGN GUIDANCE OF MUTCD

- Follows MUTCD (Chapter 3) nomenclature & definitions
- Solid lines – discourage crossing
  - 4 to 6 inch lines are "normal" widths
  - "wide" lines are 2x normal widths to add emphasis
- Double solid lines prohibit crossing
- Dotted lines provide guidance or warning (dashed, broken)



GREEN COLORED BICYCLE LANES

- Guide incorporates Green Lane FHWA interim approval
  - http://mutcd.fhwa.dot.gov/resources/interim_approval/ia14/ia14grnpmbiketlanes.pdf



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Memorandum

Subject: **INFORMATION**: MUTCD – Interim Approval for Optional Use of Green Colored Pavement for Bike Lanes (IA-14)

Date: APR 15 2011

From: Jeffrey A. Lindley
Associate Administrator for Operations

In Reply Refer To: HOTO-1

To: Federal Lands Highway Division Engineers
Division Administrators

Purpose: The purpose of this memorandum is to issue an Interim Approval for the optional use of green colored pavement in marked bicycle lanes and in extensions of bicycle lanes through intersections and other traffic conflict areas. Interim Approval allows interim use, pending official rulemaking, of a new traffic control device, a revision to the

GREEN COLORED BICYCLE LANES

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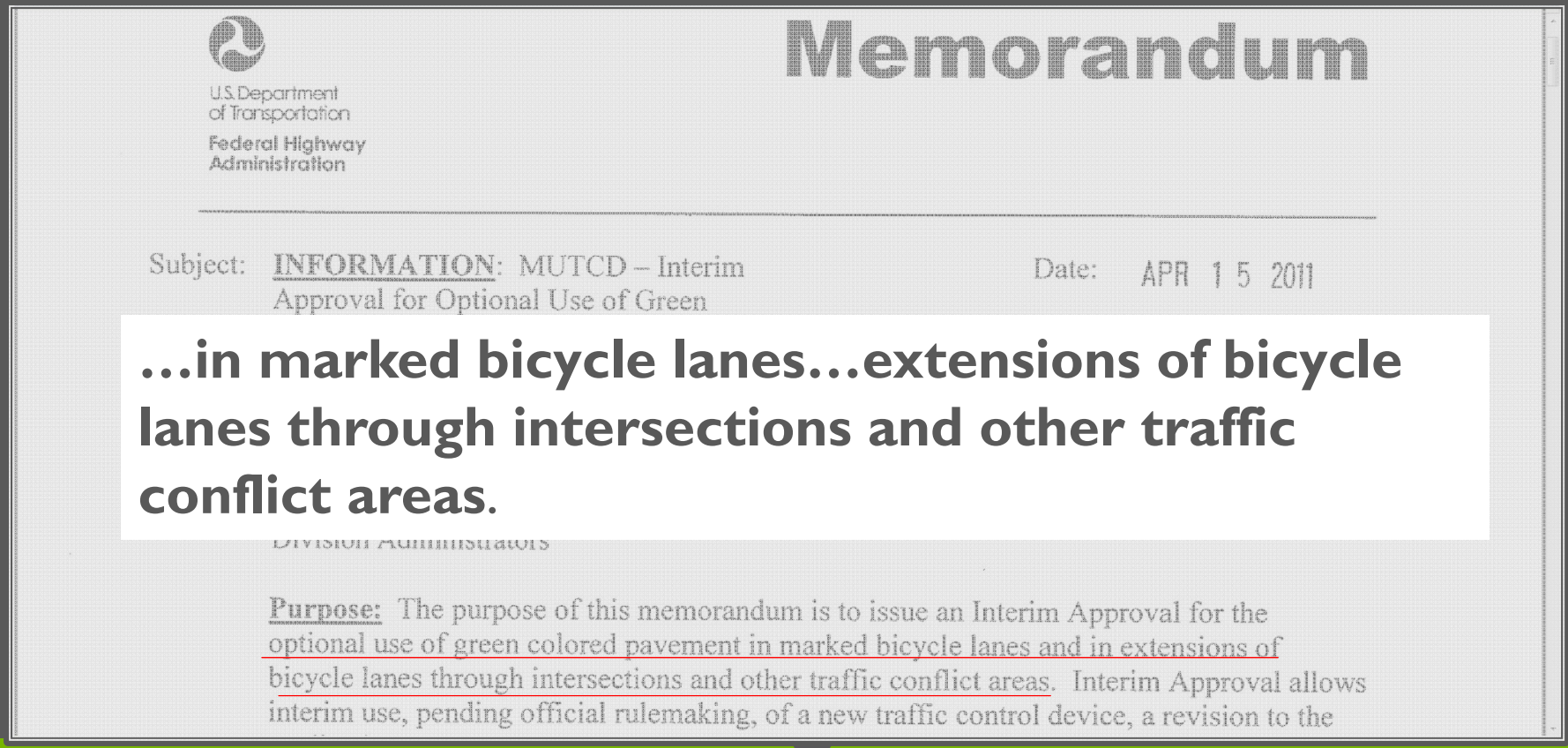
  - http://mutcd.fhwa.dot.gov/resources/interim_approval/ia14/ia14grnpmbiketlanes.pdf



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Memorandum

Subject: **INFORMATION**: MUTCD – Interim Approval for Optional Use of Green

Date: APR 15 2011

…in marked bicycle lanes…extensions of bicycle lanes through intersections and other traffic conflict areas.

Division Administrators

Purpose: The purpose of this memorandum is to issue an Interim Approval for the optional use of green colored pavement in marked bicycle lanes and in extensions of bicycle lanes through intersections and other traffic conflict areas. Interim Approval allows interim use, pending official rulemaking, of a new traffic control device, a revision to the

COLORED PAVEMENT

CHAPTER 4 – MAJOR CONTENT CHANGES

New Bike Lane Content

- Value of bike lanes
- Bike lane width nuances
- Climbing lanes
- On street parking strategies
- Expanded intersection guidance
- Roadway retrofit strategies

BICYCLE LANE VS WIDE OUTSIDE LANE

1999 Guide

"Wide curb lanes for bicycle use are usually preferred where shoulders are not provided, such as in restrictive urban areas."

BICYCLE LANE VS WIDE OUTSIDE LANE

2012 Guide

"The provision of wide outside lanes should also be weighed against the likelihood that motorists will travel faster in them…, resulting in decreased level of service for bicyclists and pedestrians.

Bike lanes are the appropriate and preferred bicycle facility for thoroughfares in both urban and suburban areas."

CHAPTER 4 – MAJOR CONTENT CHANGES

Innovative Designs

- Green bike lanes
- Buffered bike lanes
- Contra-flow bike lanes
- Climbing Lanes
- Accommodating left turns
- Back-in angle parking

BICYCLIST BASICS

- Same access & mobility needs as motorists
- Crashes in urban areas highest at intersections
- Operating speed and acceleration rates vary
- Sensitive to traffic speeds, volumes, trucks, terrain, and lateral separation
- Vulnerable roadway user

BICYCLIST AND BICYCLE LANE BASICS

- Allow cyclists to choose operating speed
- Preferred over shared lanes/wide outside lanes
- Bicyclists prefer bicycle lane continuity
- Still sensitive to adjacent traffic volumes and speeds

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ENGINEERING JUDGMENT

"The treatments described reflect typical situations; local conditions may vary and engineering judgment should be applied."

BICYCLE LANE WIDTHS

- …widths should be determined by context and anticipated use.
- Measure to center of line
- Bicyclists preferred operating width is at least 5 feet

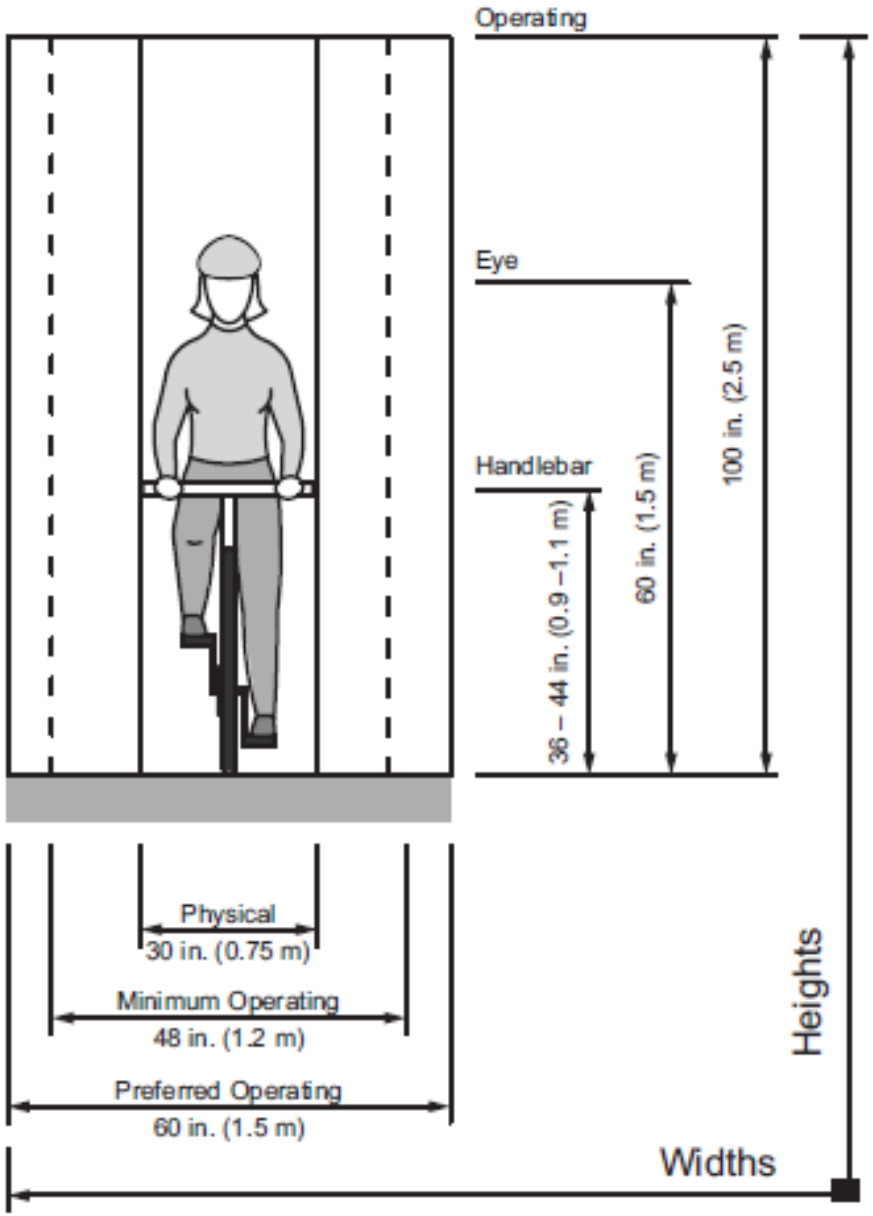
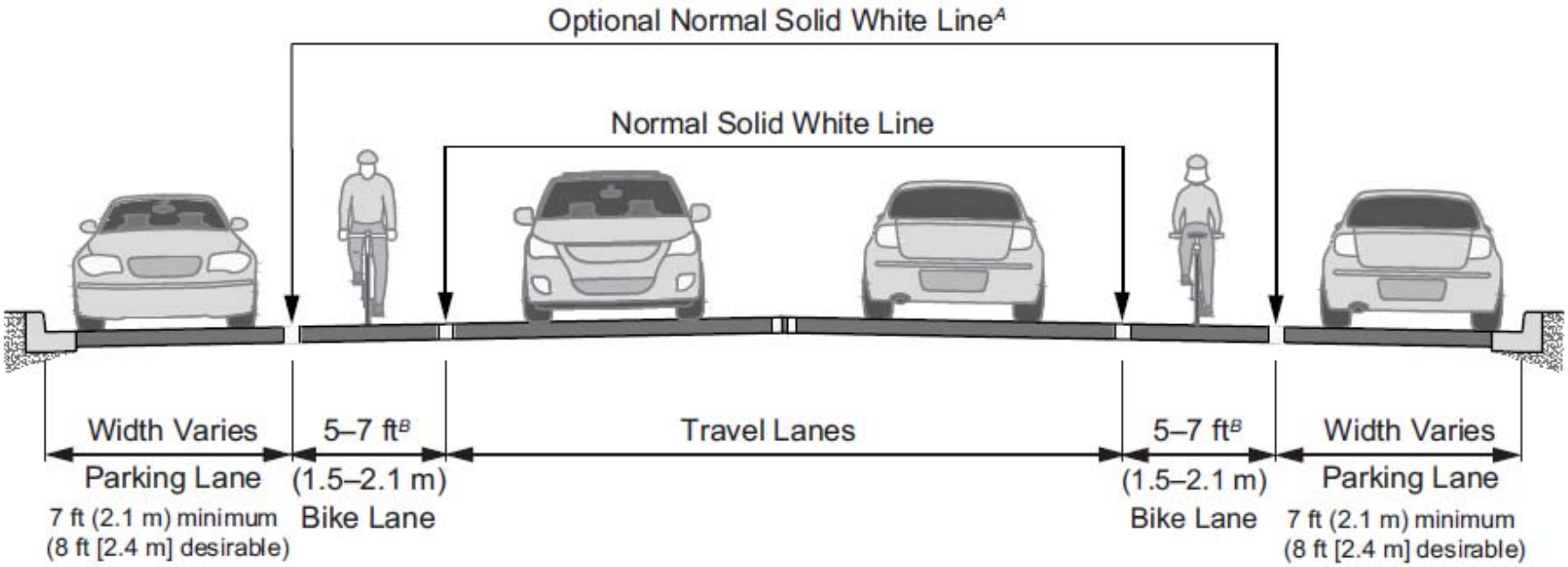
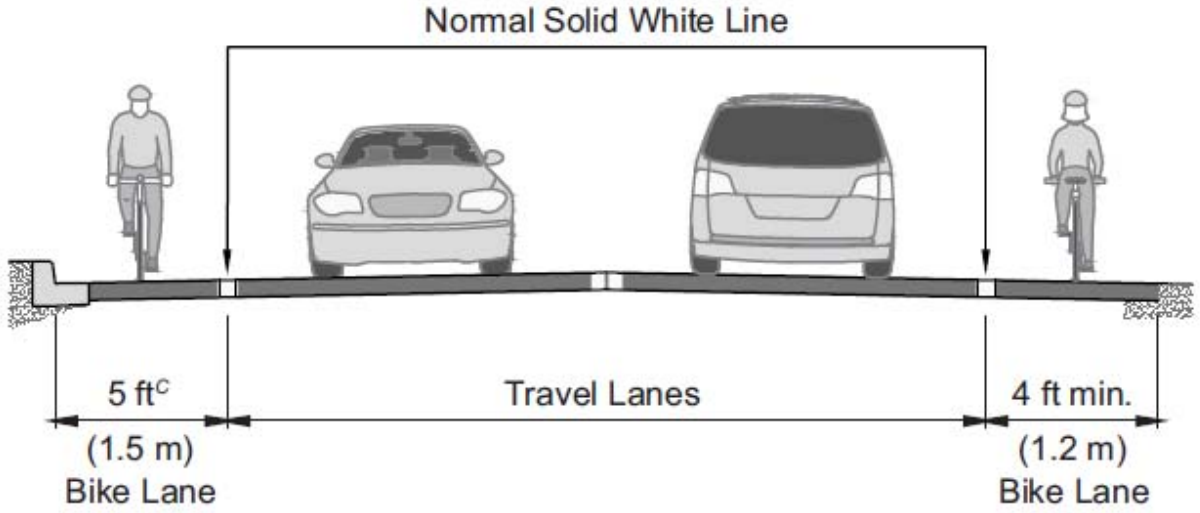


Figure 3-1. Bicyclist Operating Space



On Street Parking



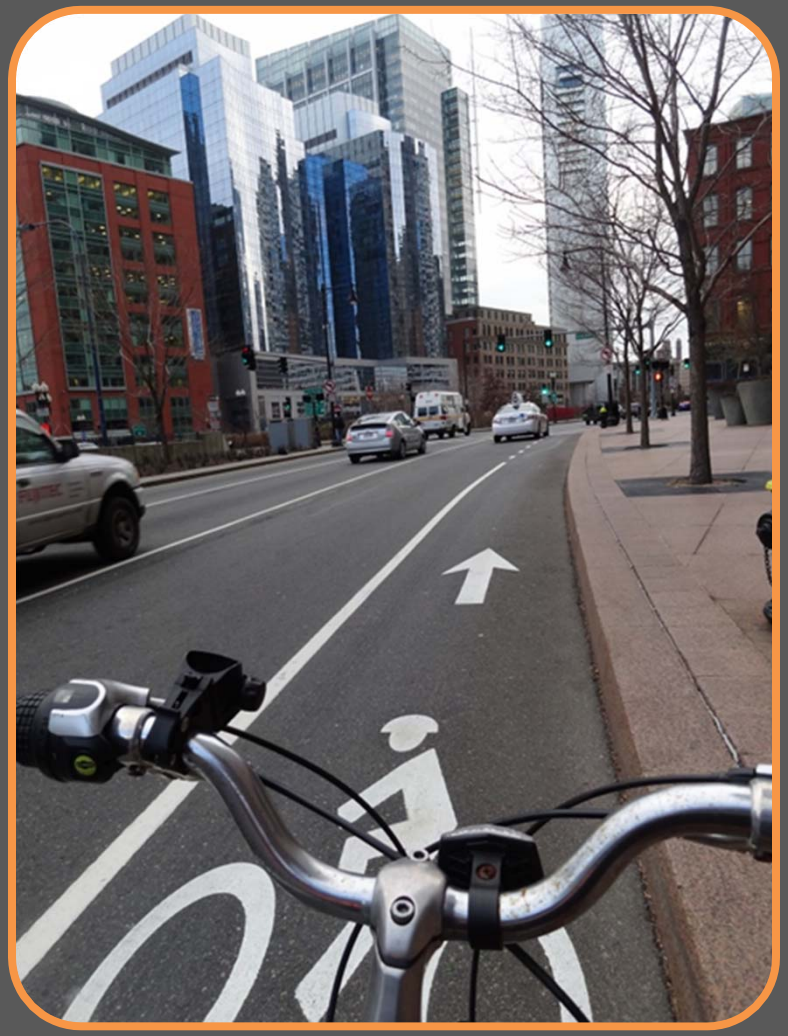
Parking Prohibited

BICYCLE LANE WIDTHS
NO GUTTER, CURB, OR PARKING

- 4 foot minimum

BICYCLE LANE WIDTHS
NO GUTTER WITH CURB (NO PARKING)

- 5 foot typical
- 4 foot allowed
  - Constrained, low speed roads
  - All other lanes narrowed first
- Additional width improves comfort and safety



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BICYCLE LANE WIDTHS WITH GUTTER AND CURB

- 5 foot minimum with 12-inch gutter
- 6 foot minimum with 24-inch gutter
- Additional width improves comfort and safety

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DRAINAGE CONSIDERATIONS WITH CURBSIDE BIKE LANES

- Useable width of 4 feet is recommended
- Drainage grates
  - Reduce effective width of bike lane
  - Use bicycle compatible grates
- Widen bike lane or relocate grate if the clear bike lane operating space falls below 4 feet

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BICYCLE LANE WIDTHS ADJACENT TO PARALLEL PARKING

- Bike lane width:
  - 5 foot minimum
  - 6 or 7 foot width adjacent to high turnover parking
  - Wider lanes where parking in high demand may encourage double parking
- Parking lane width:
  - 8 foot desirable
  - 7 foot minimum

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BICYCLE LANE WIDTHS ADJACENT TO PARALLEL PARKING

- Combined bike and parking lane width should be a minimum of 13 feet where parking line is not utilized

BICYCLE LANE WIDTHS ADJACENT TO PARALLEL PARKING

- Combined bike and parking lane width may be a minimum of12 feet where parking line is marked

DOORING CONCERNS

DESIGNS TO REDUCE DOORING

Wider Bike Lanes

Wider Parking Lanes

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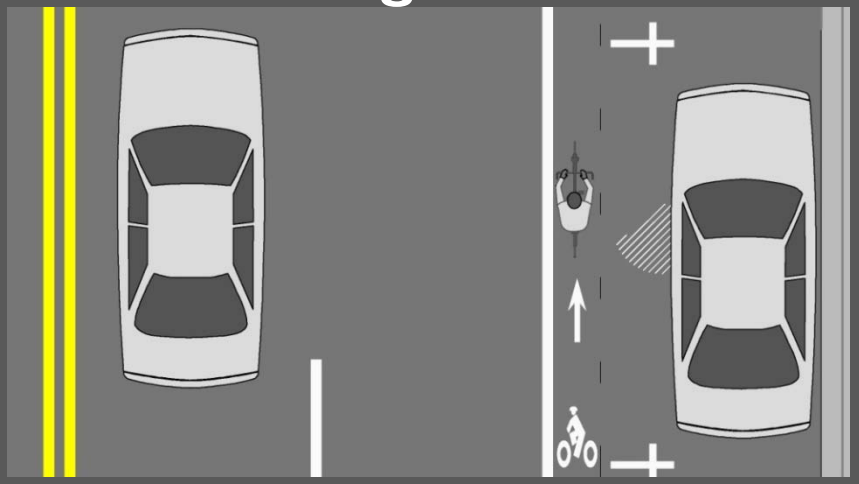
DESIGNS TO REDUCE DOORING

Buffered door zone

Parking "Tees"



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DESIGNS TO REDUCE DOORING

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BIKE LANES AND ANGLED PARKING

"Bike lanes should normally not be placed adjacent to conventional front-in diagonal parking . . ."

BIKE LANES AND ANGLED PARKING

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BIKE LANES AND ANGLED PARKING

The use of back-in diagonal parking can mitigate the conflicts normally associated with front-in parking.

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BICYCLE LANE WIDTHS
SIDE BY SIDE RIDING

- Minimum widths of 6 - 8 feet:
  - Allow cyclists to ride side by side
  - Increase comfort on higher speed/volume roads
  - May be inclusive of "buffer" if present

BICYCLE LANE MARKINGS AND SIGNS

- Bike lane line and bike symbol required
- Parking line optional
- Bike lane signs optional

R3-17

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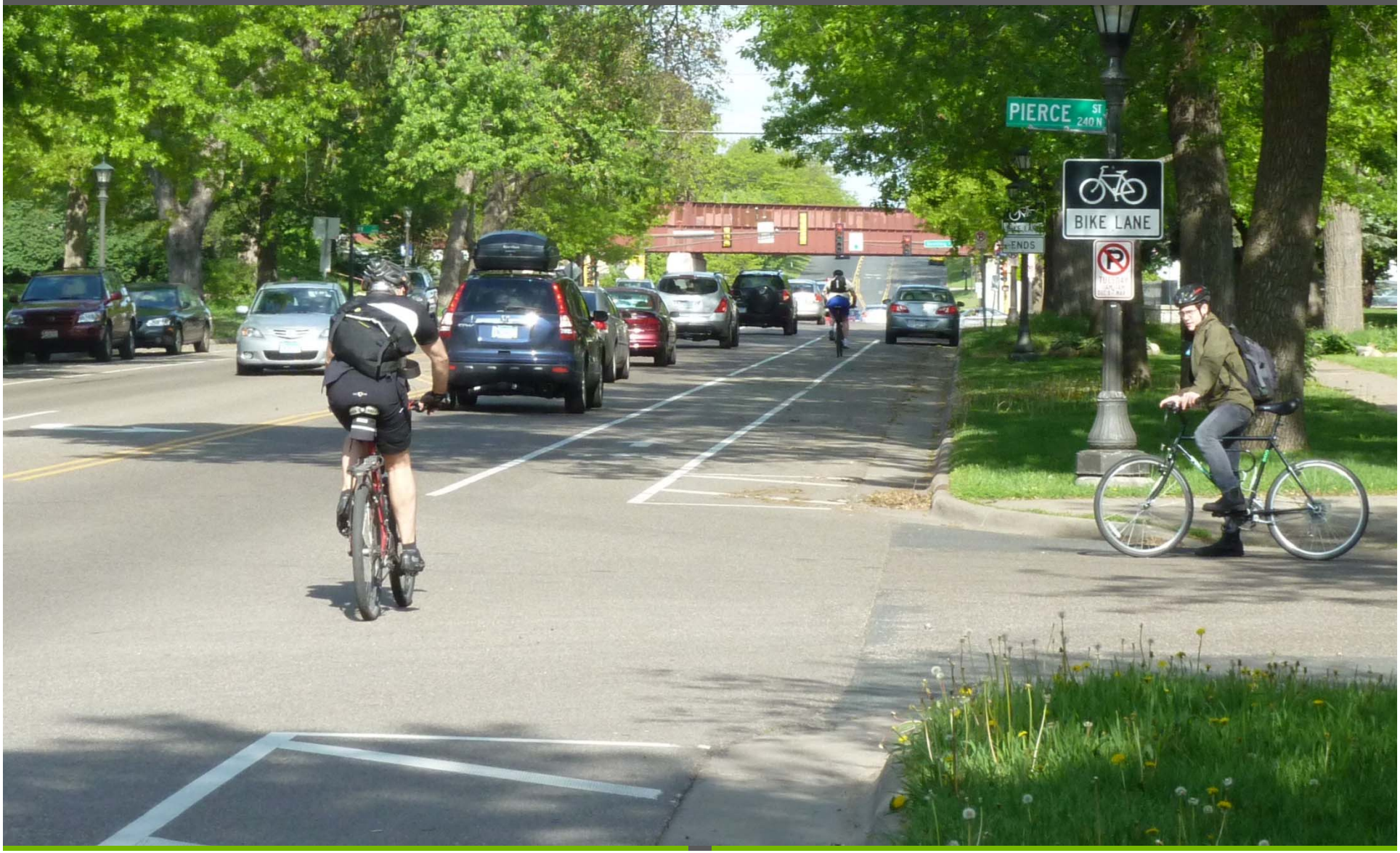
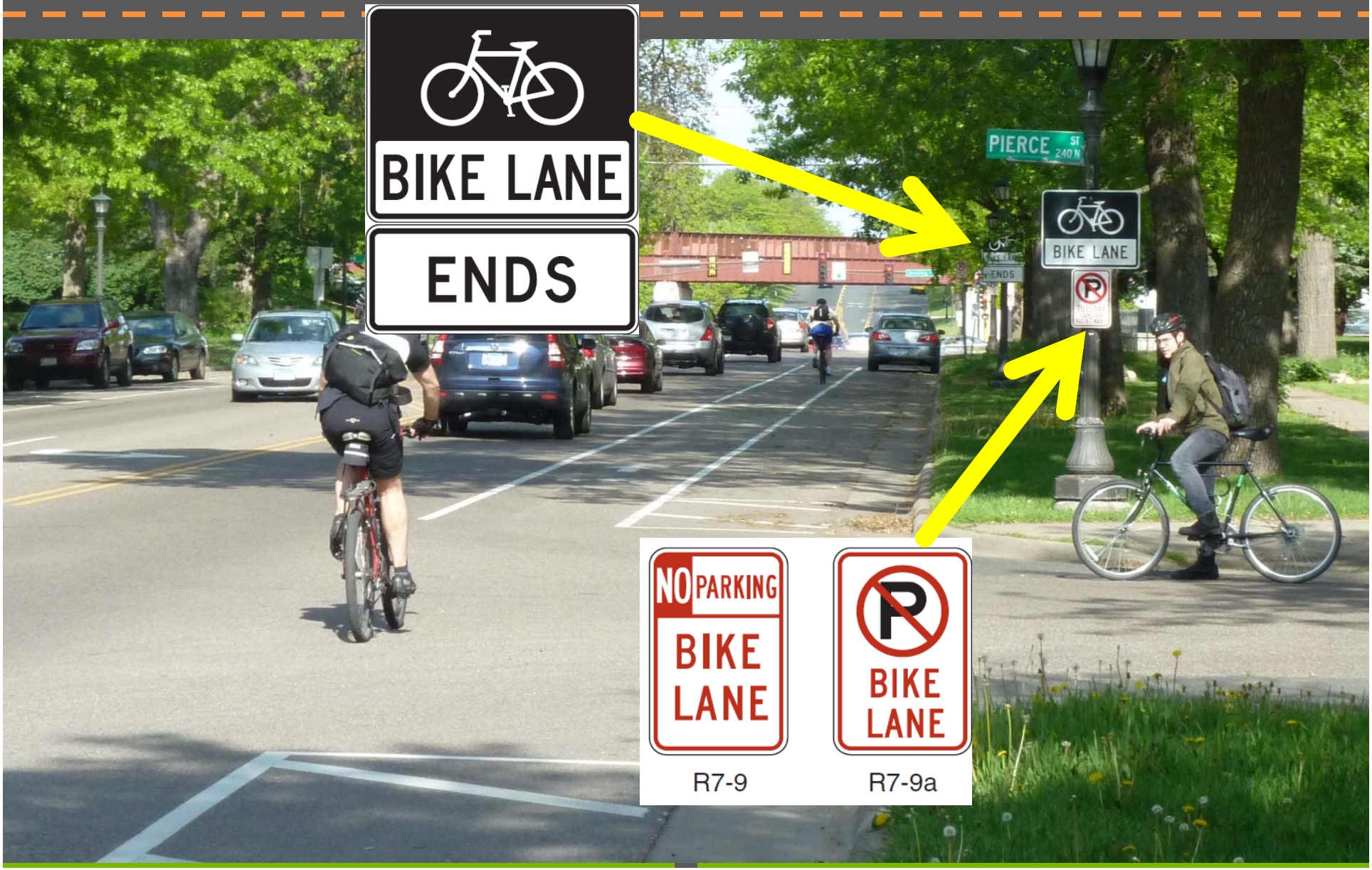
BICYCLE LANE MARKINGS AND SIGNS

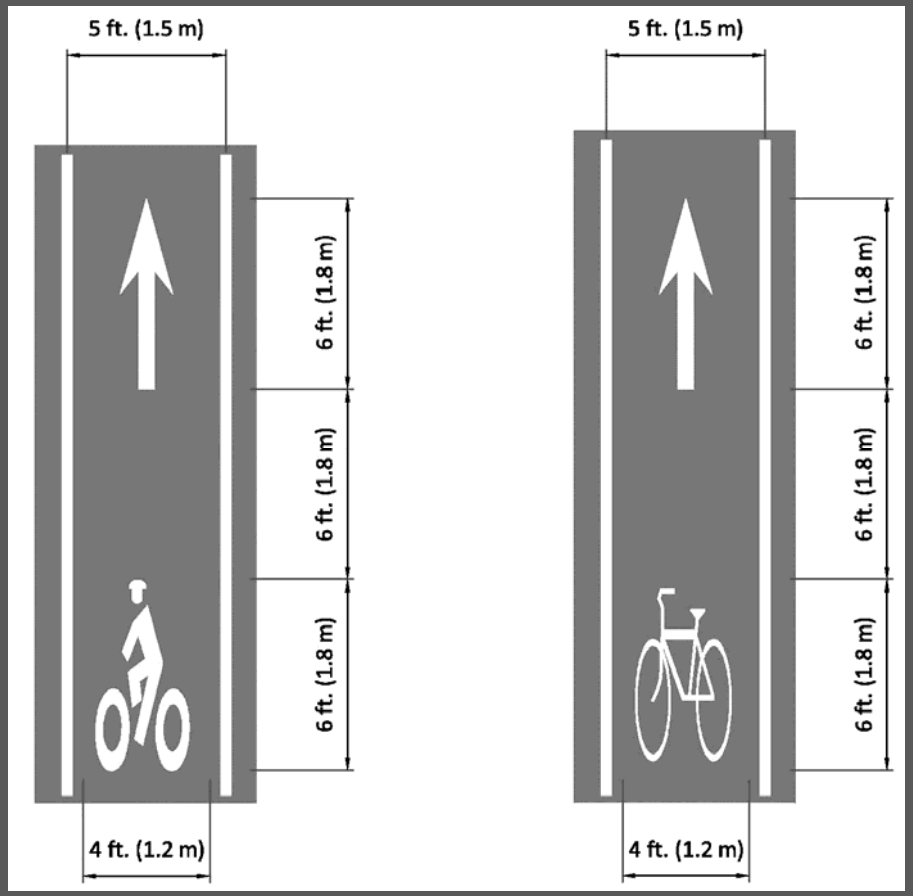


BICYCLE LANE MARKINGS AND SIGNS



BICYCLE LANE MARKINGS AND SIGNS

- Both symbols still allowed or the words "BIKE LANE"
- Symbols spaced between 100 feet and 1,000 feet
- Place close to locations motorists will cross bike lanes



BICYCLE LANES ON TWO-WAY STREETS

- In most cases, install bicycle lane on both sides of street
- In some circumstances, it may be desirable to install a bike lane on one side of a narrow street with shared lane markings opposite side (of bike lane)

CLIMBING LANES ON TWO WAY STREETS

- Install bike lane in uphill direction
- Install shared lane markings in downhill direction

BICYCLE LANES ON ONE-WAY STREETS

- Generally, right side bike lanes preferred
- Left side bike lanes can be beneficial on one-way streets:
  - high volume of left-turning bicyclists
  - To decrease conflicts with
    - Truck loading
    - Buses and transit stops
    - heavy right turn volumes
    - dooring

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CONTRA-FLOW BIKE LANES

- Placed on the right side of road
- Provide a bicycle facility in the "with traffic" direction
  - Bike lane
  - Shared lane marking
- Double yellow lines or physical separation

CONTRA-FLOW BIKE LANES

- Requires "Except Bicycles" supplemental plaque
- Signals oriented to bicyclists may be needed at signalized intersections

BUFFERED BIKE LANES

- Striped buffers may be used to provide increased separation to parking or travel lanes

BICYCLE LANES AT INTERSECTIONS

- Principles for good design:
  - Minimize free-flowing movements
  - Provide guidance to bicyclists and motorists
  - Direct, logical routing
  - Signal accommodations provided
- May use dotted or solid lines on approaches
  - Consider state or local laws

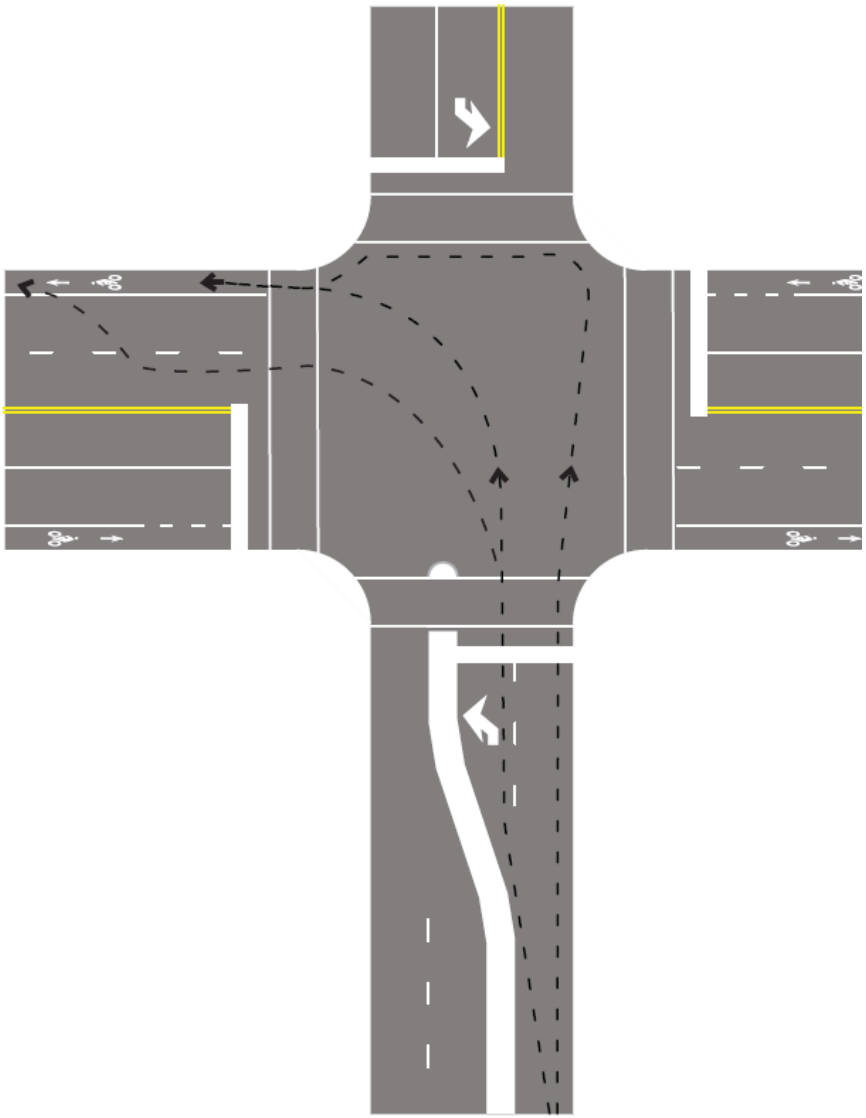

Figure 3-3. Common Maneuvers for Bicyclists Turning Left at an Intersection

BIKE LANE WIDTHS AT INTERSECTIONS

4 foot minimum

5 feet or wider preferred

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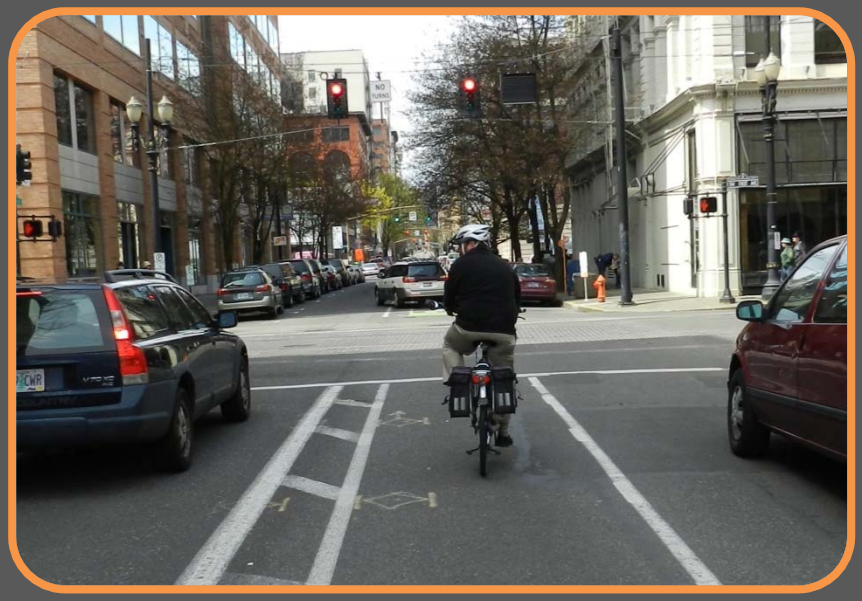
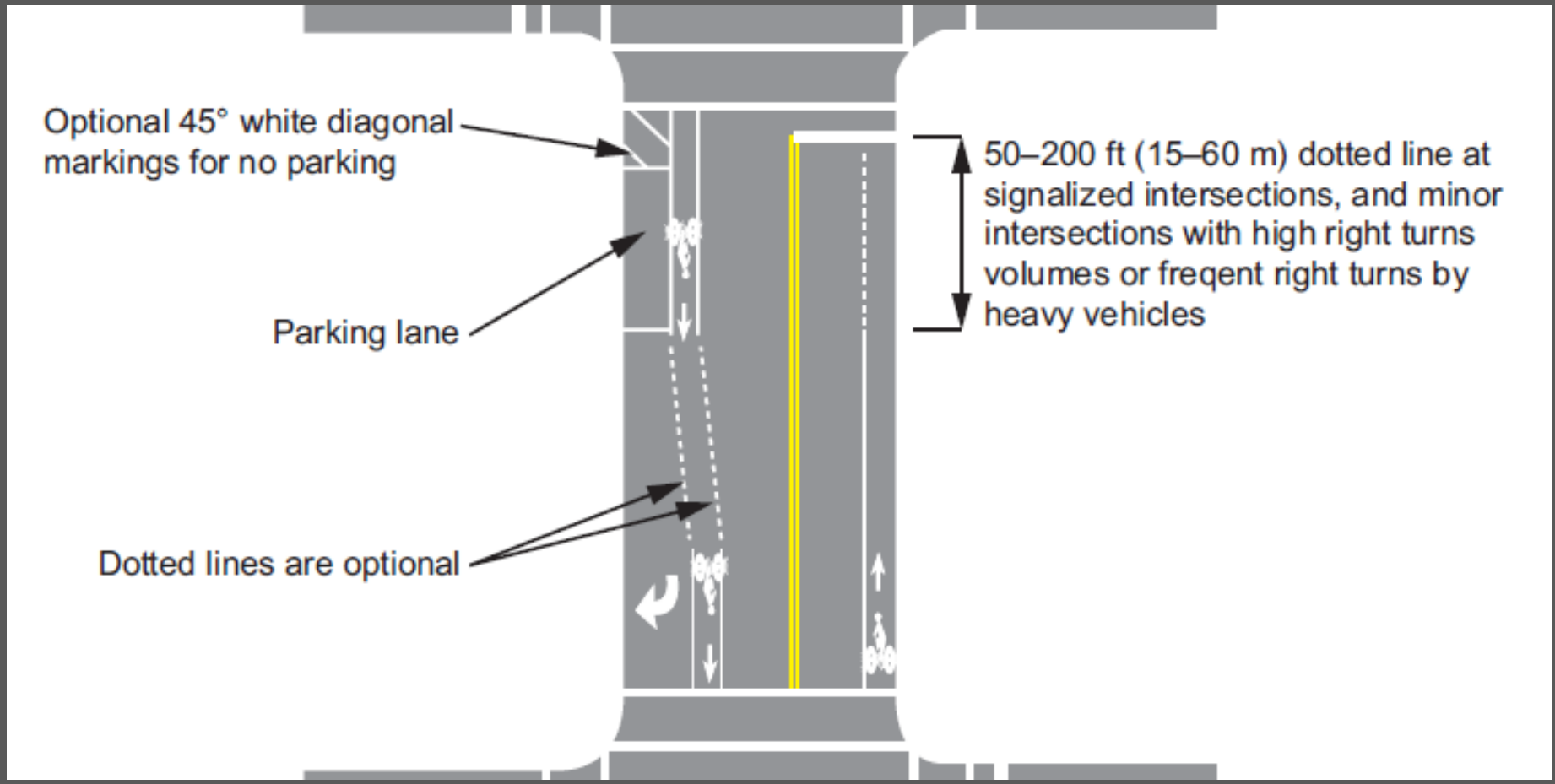
SOLID LANE LINES VS DOTTED

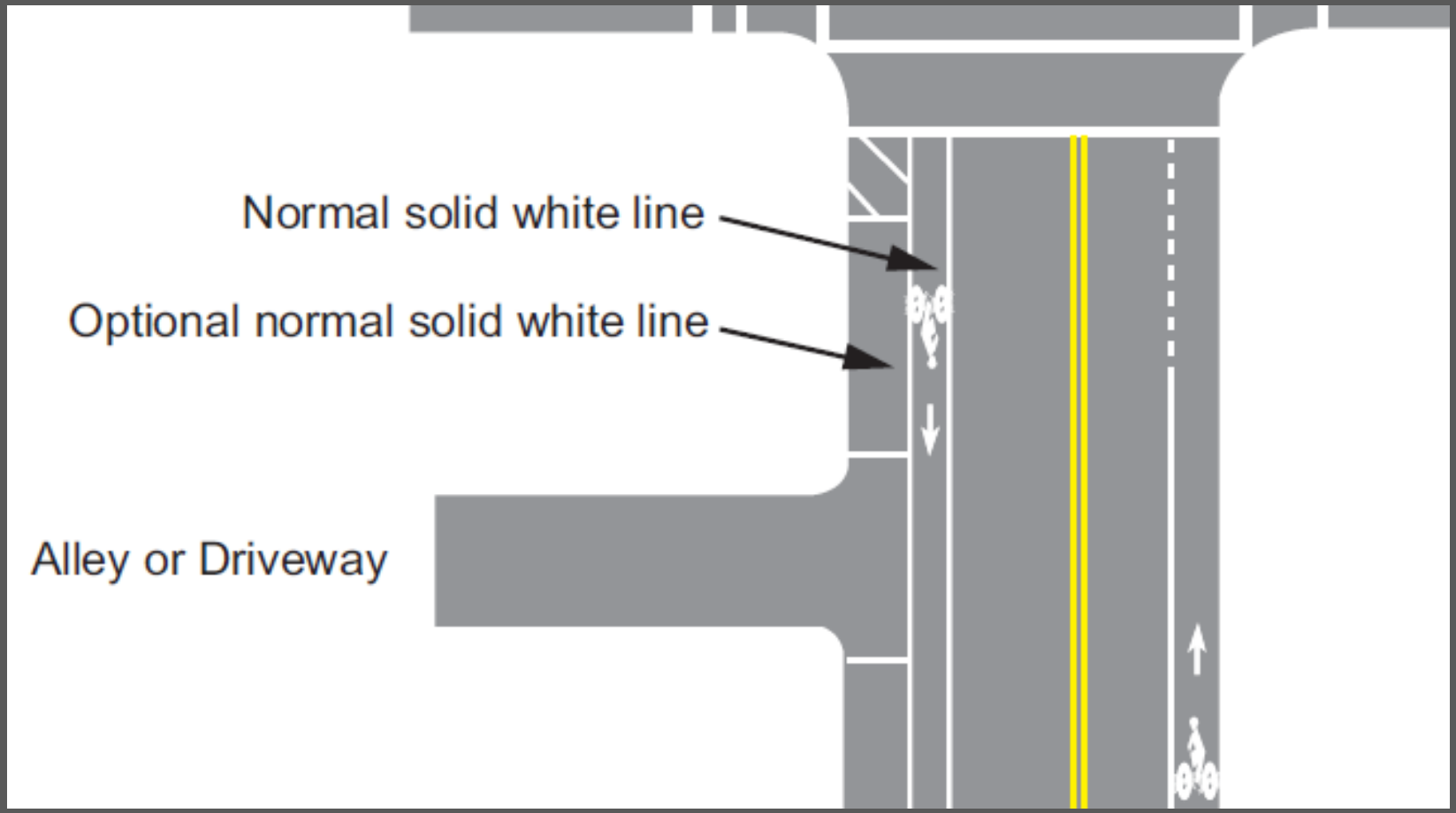
- Solid lane lines discourage crossing or merging
- Dashed lane lines encourage crossing or merging
- Consider state and local laws for motorists turning at intersections



DOTTED BIKE LANE LINES



SOLID LANE LINES



RIGHT TURN CONSIDERATIONS

- Bike lane may be dotted, solid, or dropped
- Solid or dotted?
  - Volume of right turning vehicles
  - Bus stops
  - Motor vehicle speed
  - State or local law
- Incorporate R4-4 sign at start of right turn lane

LEFT TURN CONSIDERATIONS

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DOTTED LINES THROUGH INTERSECTIONS

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DOTTED LINES AND COLORED PAVEMENT

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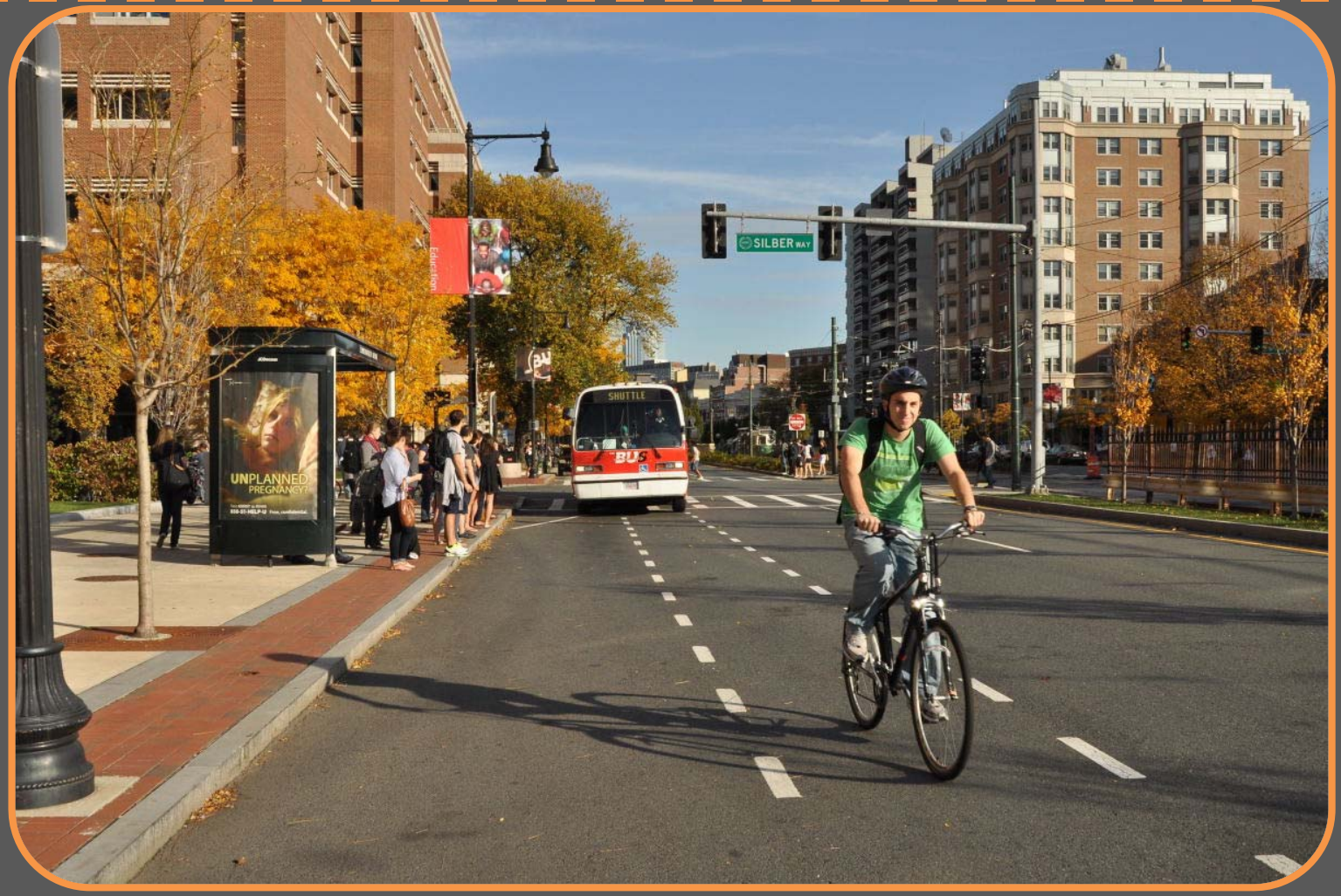
DOTTED LINES AND COLORED PAVEMENT

- Green can be dashed to match dotted lines
- Green can utilized to silhouette standard MUTCD word and symbol markings

BIKE LANES AT BUS STOPS



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RETROFITTING ON EXISTING STREETS AND HIGHWAYS

- New section
- Reallocation of Roadway Space
  - Narrowing lane widths (lane diets)
  - Removing travel lanes or parking lanes (road diets)
  - Reconfiguration or removal of parking
- Construction improvements
  - Relocate drainage inlets
  - Reconstruct or remove gutters
  - Surface repairs

ROAD DIETS

- Reducing Travel Lane Width
- Reducing the Number of Travel Lanes (4-3)
  - 15,000 vpd = Good Candidate
  - 15-20,000 vpd = Requires Engineering Study
  - 20,000+ vpd = Still Possible

ROAD DIETS – 4 LANES TO 3

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ROAD DIETS – UNBALANCED LANES

One lane approaching middle of bridge

Two lanes approaching the intersections

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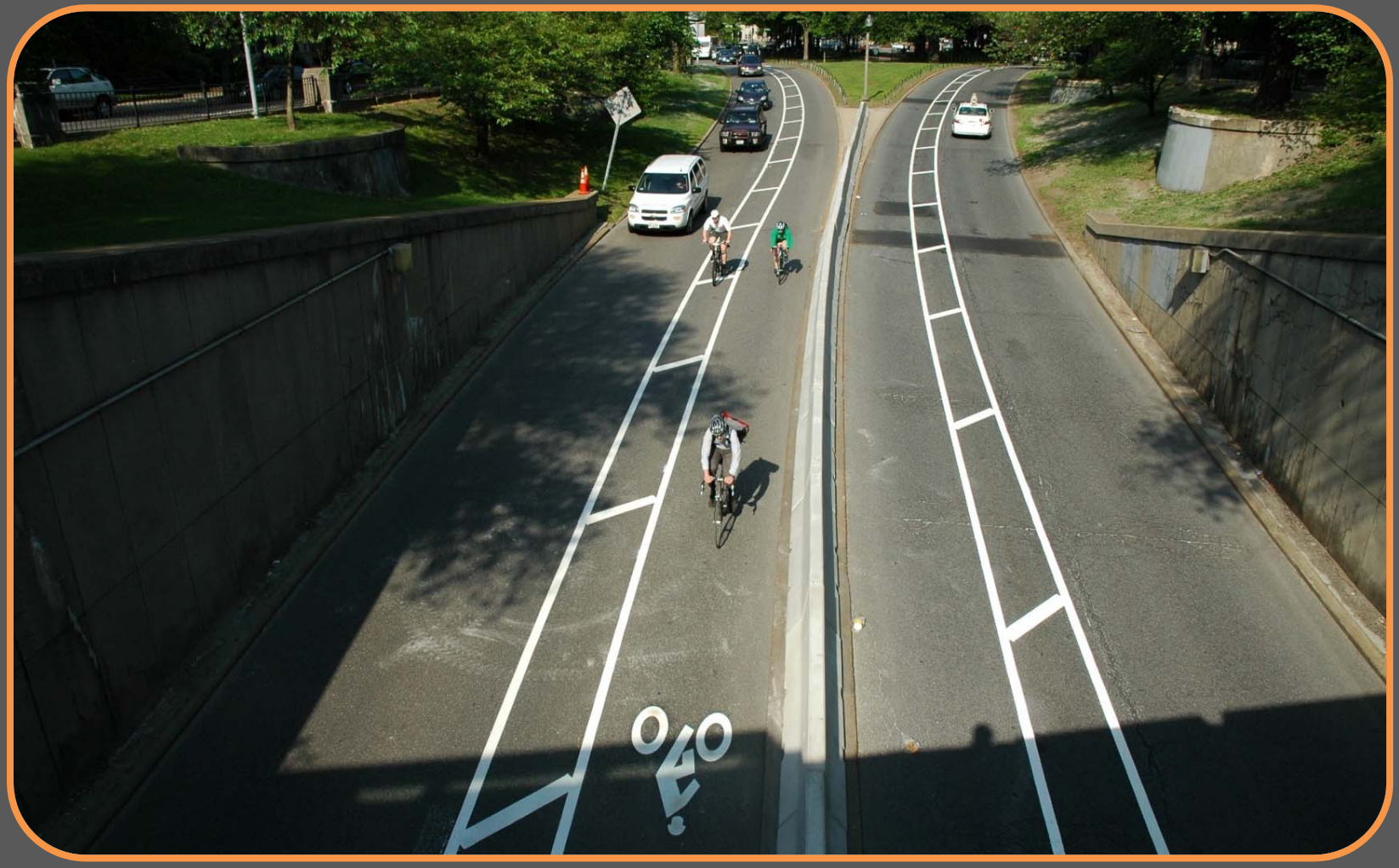
ROAD DIETS – TRAVEL LANE REMOVAL



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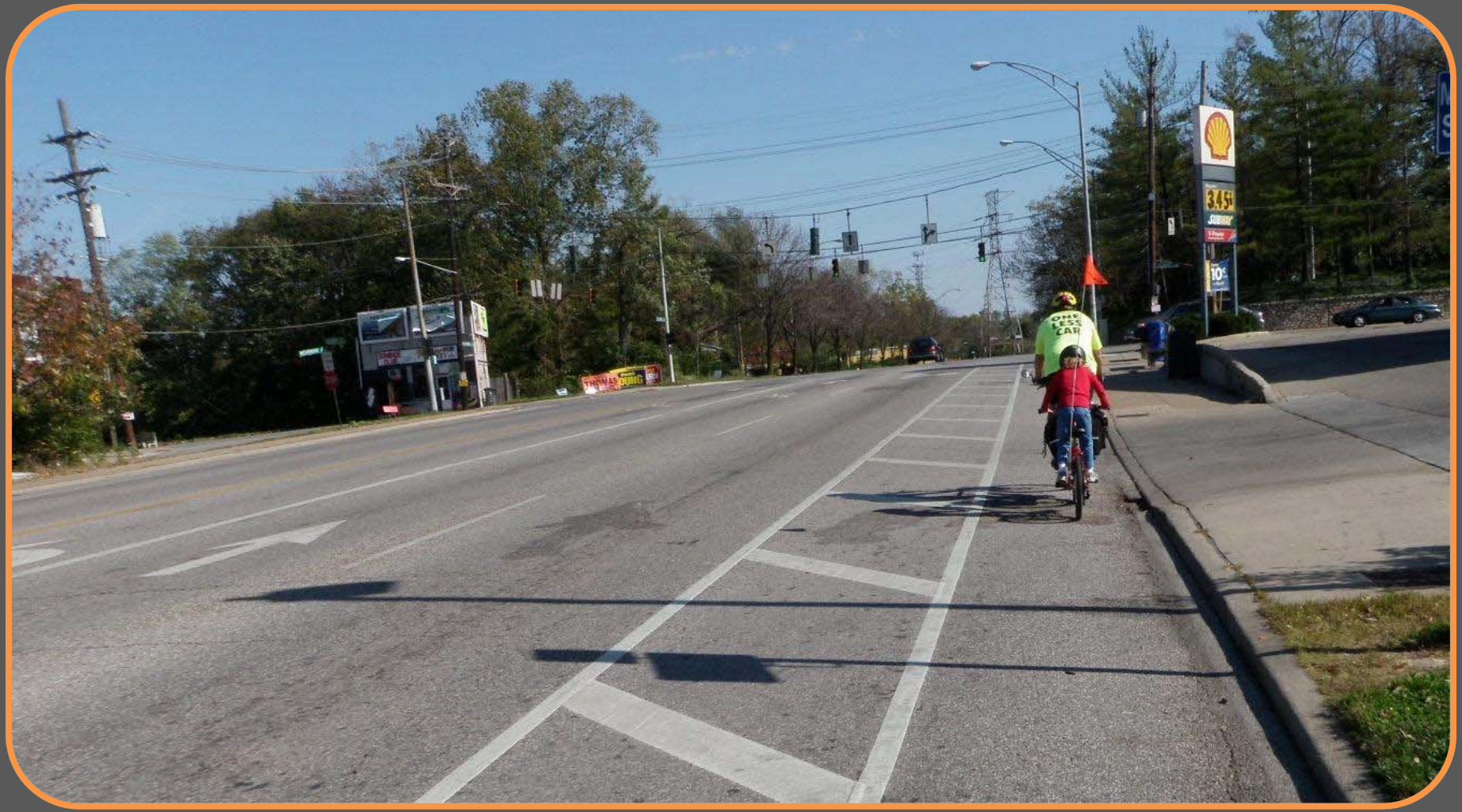
ROAD DIETS – TRAVEL LANE REMOVAL



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ROAD DIETS – TRAVEL LANE REPURPOSING

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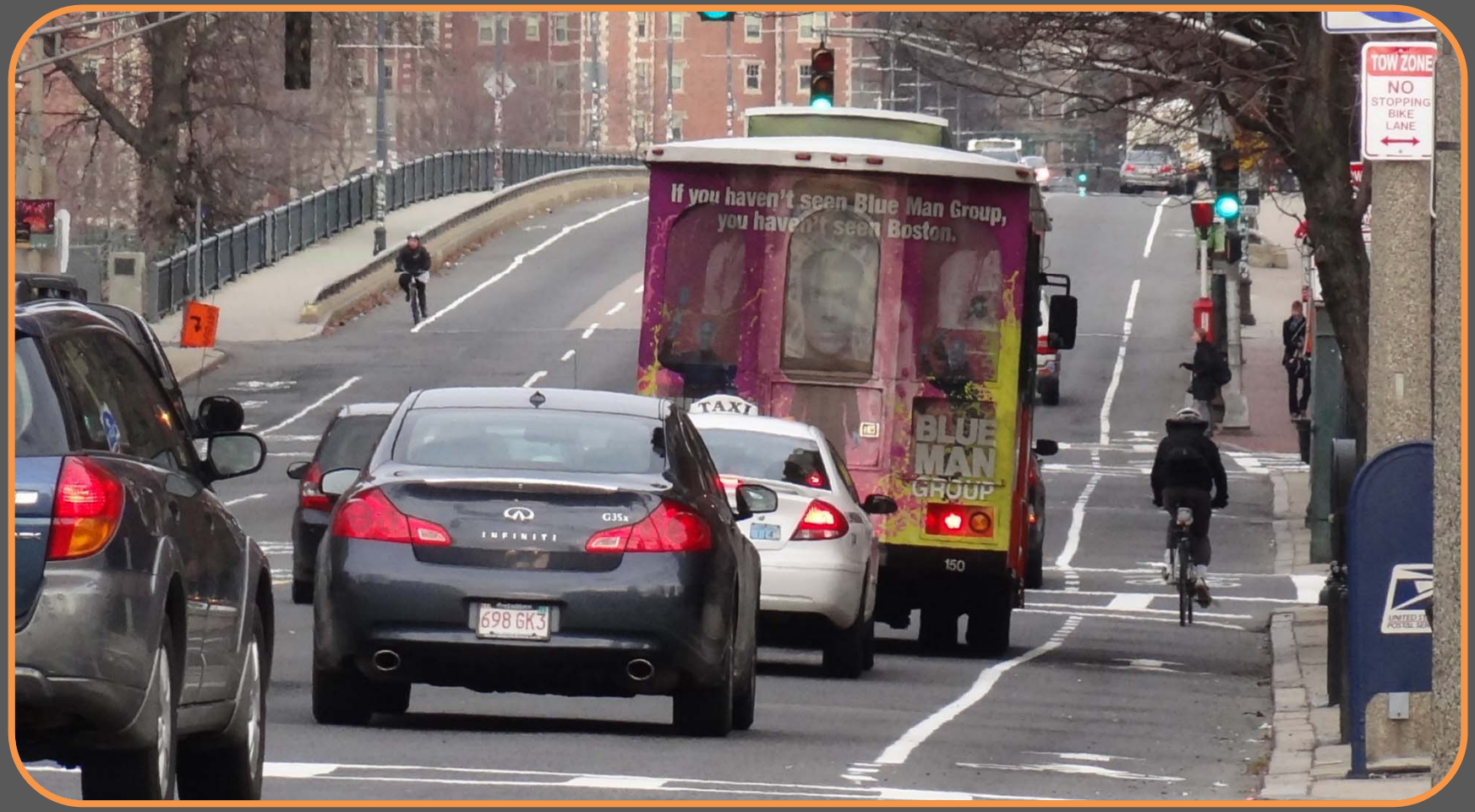
ROAD DIETS – PARKING LANE REMOVAL



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ROAD DIETS

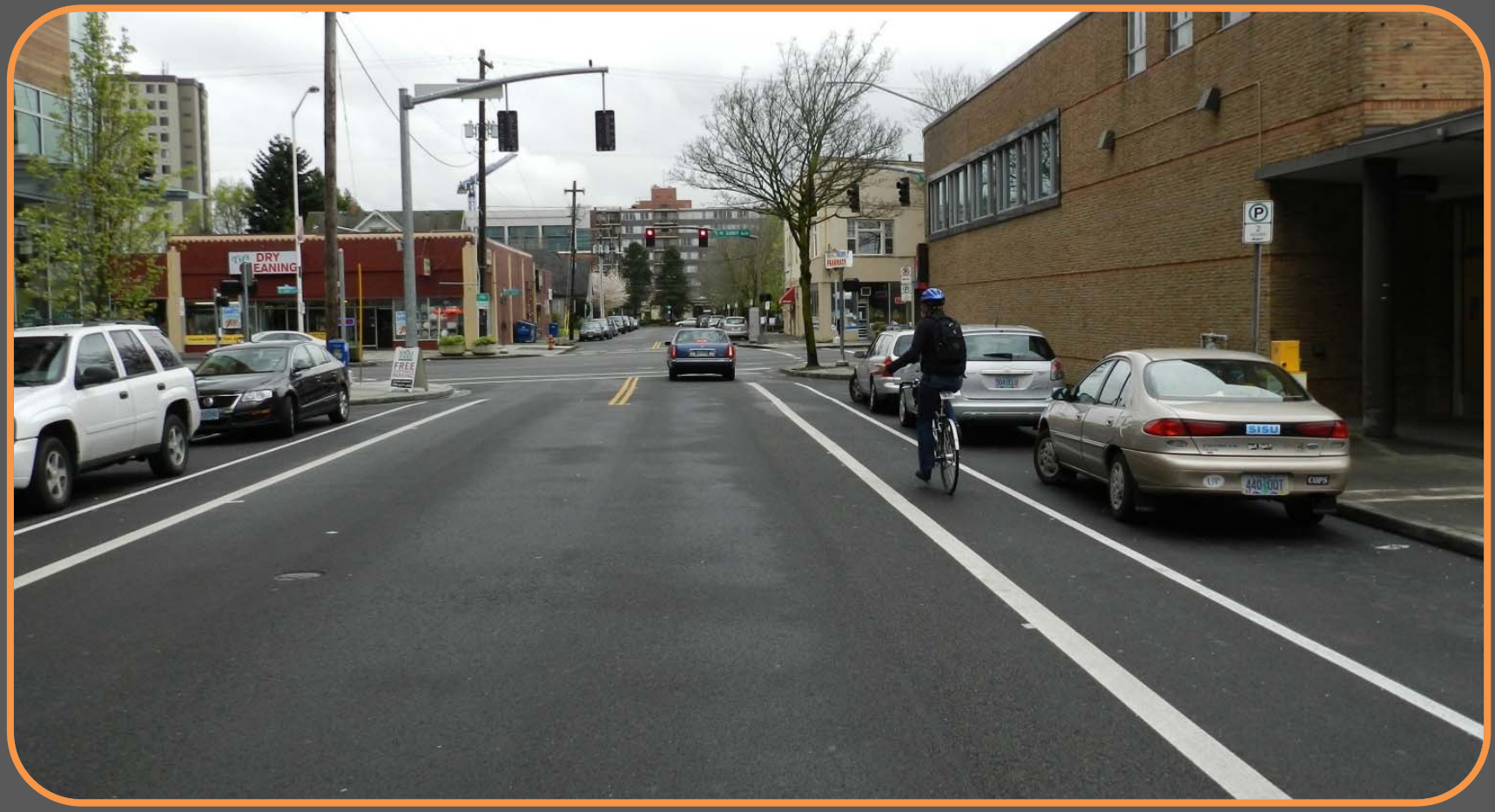
Benefits include:

- Provision of bicycle lanes
- Traffic calming/speed reduction
- Crash reductions
- Pedestrian safety
- Provision of space for turn lanes
- Reduced traffic noise
- Increased comfort to pedestrians and bicyclists

LANE DIETS

Narrow arterial lanes up to 10 feet acceptable citing research narrow lanes don't increase crash rates.

LANE DIETS



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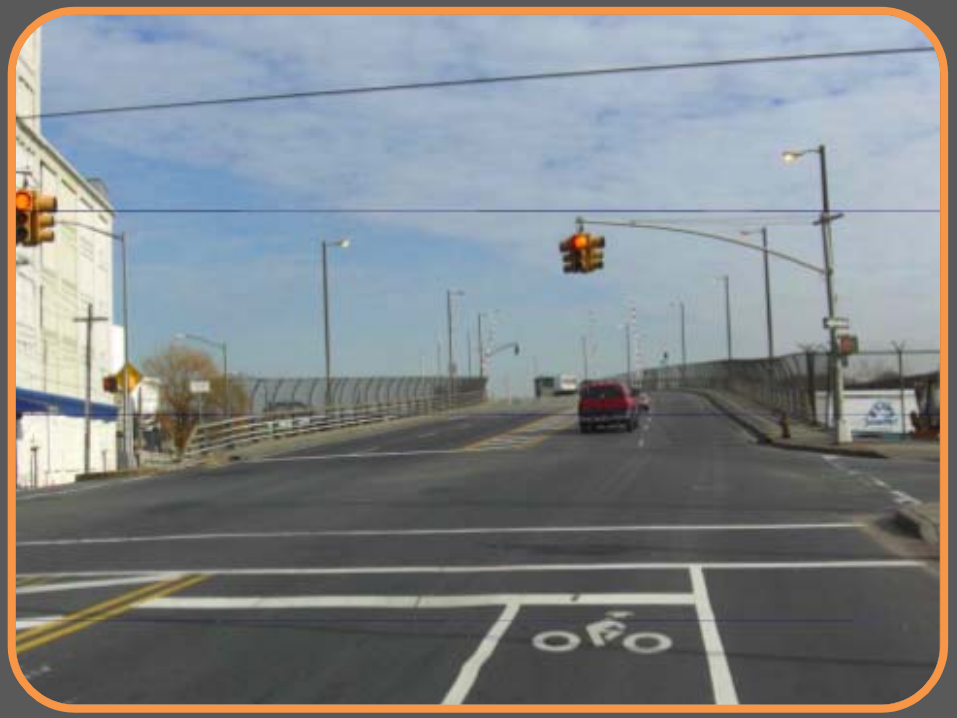
CONSTRUCTION IMPROVEMENTS

Gutter Seam Raveling

Gutter Removal

EXAMPLE APPLYING PRINCIPALS OF GUIDE TO BIKE LANE ENDS SITUATIONS



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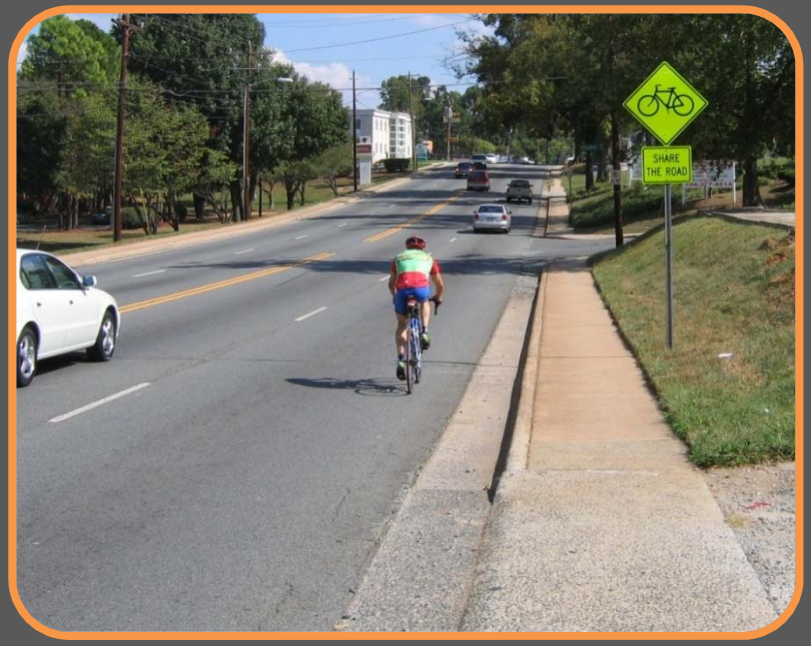
EXAMPLE APPLYING PRINCIPLES OF GUIDE TO BIKE LANE ENDS SITUATIONS

Share the Road

- Lane width ≥14 feet



Bikes May Use Full Lane

- Lane width <14 feet

THANK YOU!

Contact information:

Questions?

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FUTURE WEBINARS

- August 10: Overview
- August 22: Planning Chapter
- September 4: On-Road Bikeways Part I
  - Bike Lanes (including Intersections)
- **September 18: On-Road Bikeways Part II**
  - **Shared lanes**
  - **Bicycle boulevards & signing**
  - **Signals**
- October 9: Shared Use Paths
  - General design principles
  - Pathway geometry
- October 23: Shared Use Paths
  - Intersection Design
  - Mid-block crossings
- November 6: Bikeway Maintenance and Operation

WEBINAR 4: OTHER ON-ROAD BIKEWAYS

- Design of other on-road bicycle facilities (shared lanes, paved shoulders, bike boulevards)
- Traffic signal design for bicycles
- Fundamentals of bicycle guide signs (wayfinding)

Webinar Date: September 18th

Presenters: William Schultheiss, PE & Christina Fink, PE

https://www2.gotomeeting.com/register/432436666